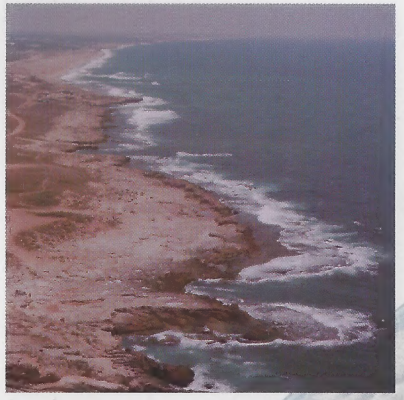
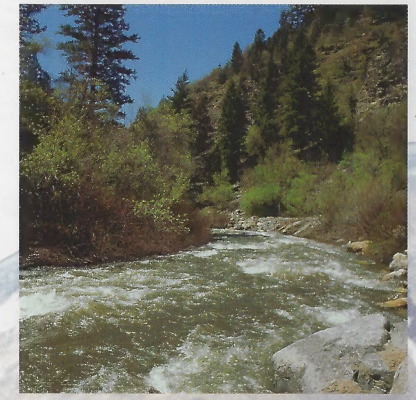
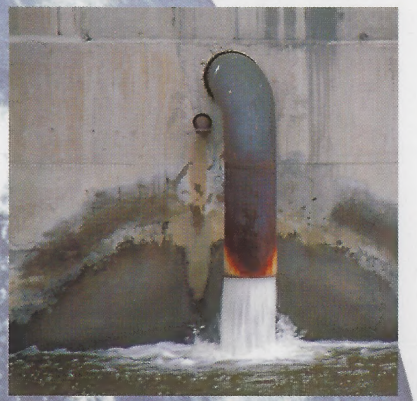
AUTOMATION AND SAMPLE PREPARATION PRODUCTS FOR ION ANALYSIS

From the World Leader in Flow Injection Analysis



LACHAT
INSTRUMENTS

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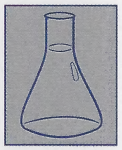
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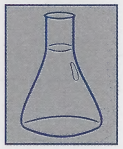
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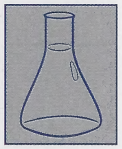
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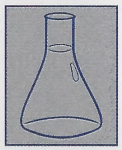
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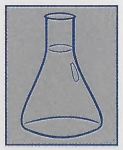
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Fast, accurate, reproducible technology... The ideal solutions for improving productivity in analyzing ionic species.

In 1980, Lachat Instruments shipped its first automated ion analyzer based on flow injection analysis.

Since that time, the company has continuously improved its existing products and diversified the product line to address the needs of laboratories determining ionic species in a wide variety of sample types. Now Lachat Instruments offers a wide range of products to meet the ever-increasing demands for improving productivity and data quality in laboratories worldwide. According to company President and CEO, Craig Ranger, "Of greatest importance throughout the organization is providing innovative and high quality products and services to meet or exceed customer expectations." The foundation for Lachat Instruments is presented in our Mission Statement.

Mission Statement

Lachat Instruments is committed to being a leading, innovative world-class supplier of analytical instrumentation designed to improve both laboratory productivity and data quality.

Lachat Instruments adheres to the tenets of Total Quality Management and meets customer expectations by providing the highest quality products and services compatible with reasonable profit objectives.

Lachat Instruments promotes personal development and company growth by enabling individuals to realize their full potential through continuing education, motivation and empowerment.

Lachat Instruments Corporate Headquarters, Milwaukee, Wisconsin, U.S.A.

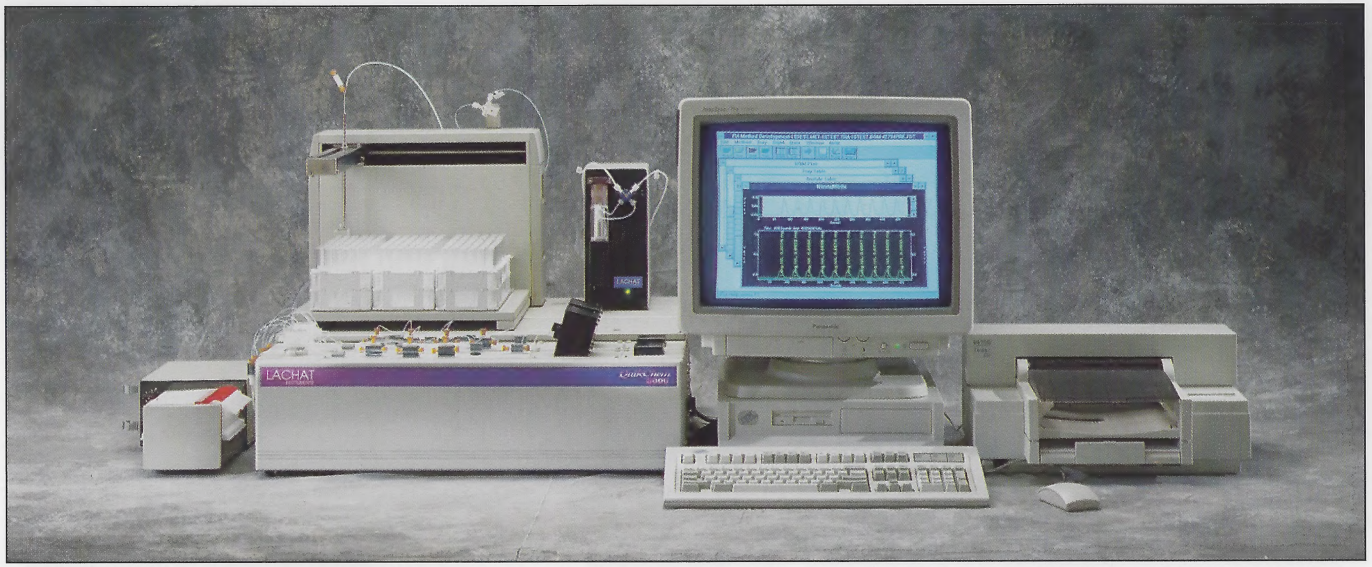
Continuum™ Ion Analyzer Series

Lachat Instruments offers comprehensive solutions to your ion analysis problems - today and tomorrow. With the QuikChem® Continuum series of ion analyzers, the investment you make today will still be adding value to your laboratory for years to come.

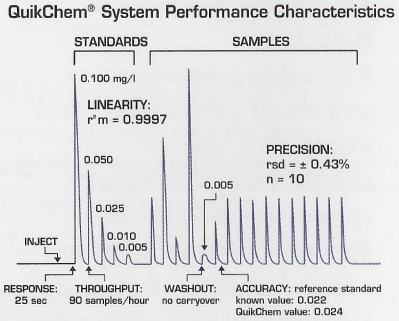
The Continuum series makes serious business out of preventing obsolescence of expensive capital equipment. You can start with an economical entry-level system. Then, as sample volumes increase and budgets expand, your instrument can evolve with your needs through several stages, all the way to the most automated configuration available.

Protect your investment with the QuikChem Continuum Ion Analyzer Series

Flow Injection Analysis, Ion Chromatography and Mercury Analysis - All in One Instrument
The Continuum series starts with a semi-automated system based on either flow injection analysis (FIA), ion chromatography (IC), or mercury analysis (Hg) depending on the initial requirements of your laboratory. If you have many samples with a few different analytes, FIA is likely the technique of choice. Alternatively, if you have only a few samples and several analytes of the same ionic class, IC is probably for you.



QuikChem 8000 Automated Ion Analyzer (FIA Compact)



Determination of Low Level Ammonia in Estuarine Water

The following pages describe the several QuikChem Continuum configurations and Table I provides a convenient summary of the components included in each configuration.

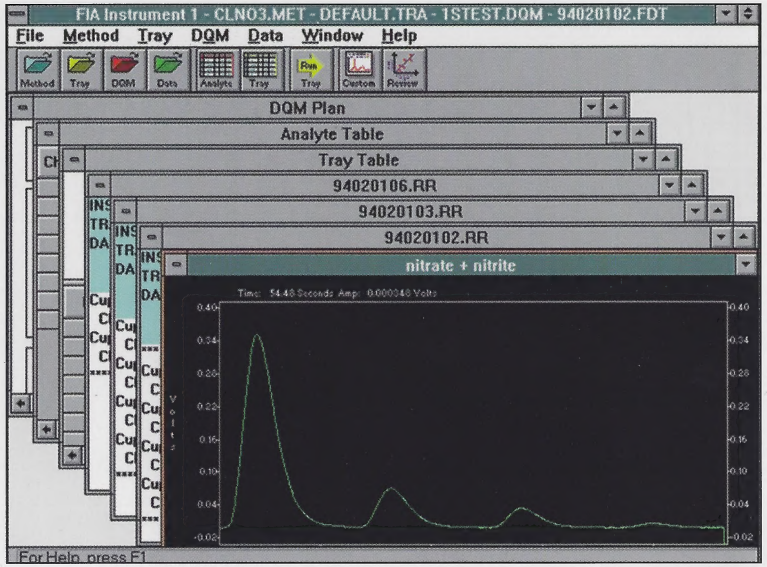
QuikChem Flow Injection Analysis

The QuikChem 8000 is a fully automated solution for determining ionic species in a variety of sample matrices over a wide range of concentrations. Up to eight analytes can be determined simultaneously. By providing separate parallel sample processing channels, there is no interaction among analytes and an optimal analytical environment is established for each analyte with respect to sample matrix and concentration range.

Based on the patented technology of flow injection analysis, the QuikChem 8000 FIA offers many benefits to the busy analytical laboratory including...

- **Windows™-Based Software**
  Based on the popular Windows operating system, the QuikChem 8000's Omnion software offers the most advanced computing environment available for flow injection analysis.

- **Simultaneous Operation of Ion Chromatography or Mercury Analysis**
  Chemically-suppressed and single column ion chromatography and mercury analysis can be performed simultaneously and independently with multi-channel FIA.



Omnion Method Screen

- **In-line Distillations**
  Volatile analytes, such as cyanide, can be digested and distilled automatically, in-line.

- **Time-Proven Methods**
  The hundreds of QuikChem methods developed over the past 15 years all run on the QuikChem 8000 Continuum Series.

- **Applications Support**
  The Applications Support Group routinely develops new methods to meet customer specifications. We invite you to submit your requirements, no matter the analyte, concentration range or sample matrix, for an evaluation by our technical staff.

- **High Sample Throughput**
  Typically, between 90 and 120 samples per hour can be processed with FIA.

- **Sub-ppb Detection Limits**
  Using flow injection analysis technology, the most stringent sensitivity and selectivity requirements can be met.

- **Determination of High Concentrations**
  For concentrated analytes, FIA can perform very high ratio dilutions automatically and in-line.

- **Auto-Ranging Detectors**
  The expanded range analog-to-digital converter provides high resolution and wide dynamic range and, coupled with software, enables automatic setting of baseline and gain.

- **Automatic Standards Preparation**
  Calibration standards are prepared automatically from a stock standard using the XYZ Sampler and Dilutor.

- **XYZ Sampling**
  The XYZ Sampler offers random access to standards and samples. The unit also accommodates bulk solutions of both calibration standards and quality control samples to minimize repouring and to preserve valuable positions in the samples racks.

- **Intelligent Automated Dilution**
  If a sample goes off-scale, a proprietary software algorithm estimates the analyte concentration, calculates an appropriate dilution ratio, performs the dilution and re-runs the sample - all automatically with no operator intervention.

- **Fast Startup**
  In about five minutes, reagents are pumped into the system, the baseline is stabilized and the analyzer is ready to go.

- **Short Analysis Times**
  Following injection, the sample is processed through FIA manifolds in less than one minute.

- **Rapid Method Switching**
  In less than fifteen minutes, one method can be shut down and the other started up.

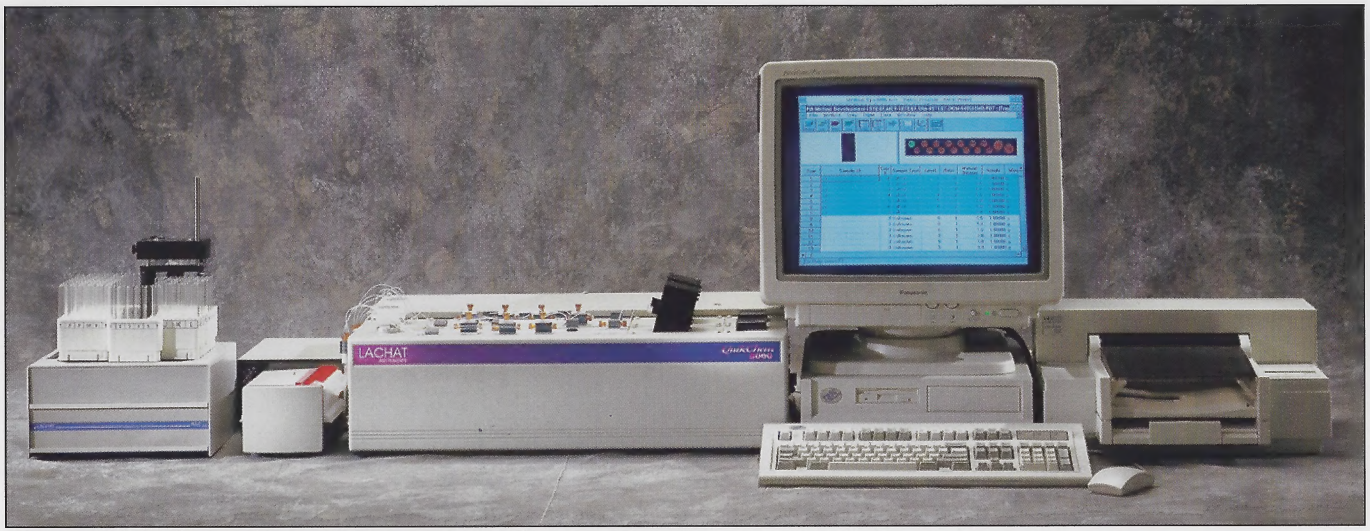
- **Real-Time Reporting**
  No waiting for results until the end of the run. All computations are made immediately after each sample is processed including corrections for baseline drift, calculations of dilution factors, weight, inter-channel relationships and user-defined functions.

- **Data Quality Management**
  Due to the short analysis times possible with FIA, data quality can be monitored in real-time and corrective action taken as required if user-specified QC limits are exceeded. This unique feature prevents inaccurate data from being generated and saves valuable time by eliminating the need for manual QC audits and post-run corrective action.

- **Available Compact Configuration**
  Where benchspace is limited, the QuikChem 8000 can be configured with the sampler and dilutor behind the instrument with systems having up to four channels.

QuikChem 4000

The QuikChem 4000 incorporates all of the features of the QuikChem 8000 except that it uses an intelligent sequential sampler and does not accommodate a dilutor. However, the QuikChem 4000 can be upgraded in the field to an XYZ random access sampler and an automated dilutor.



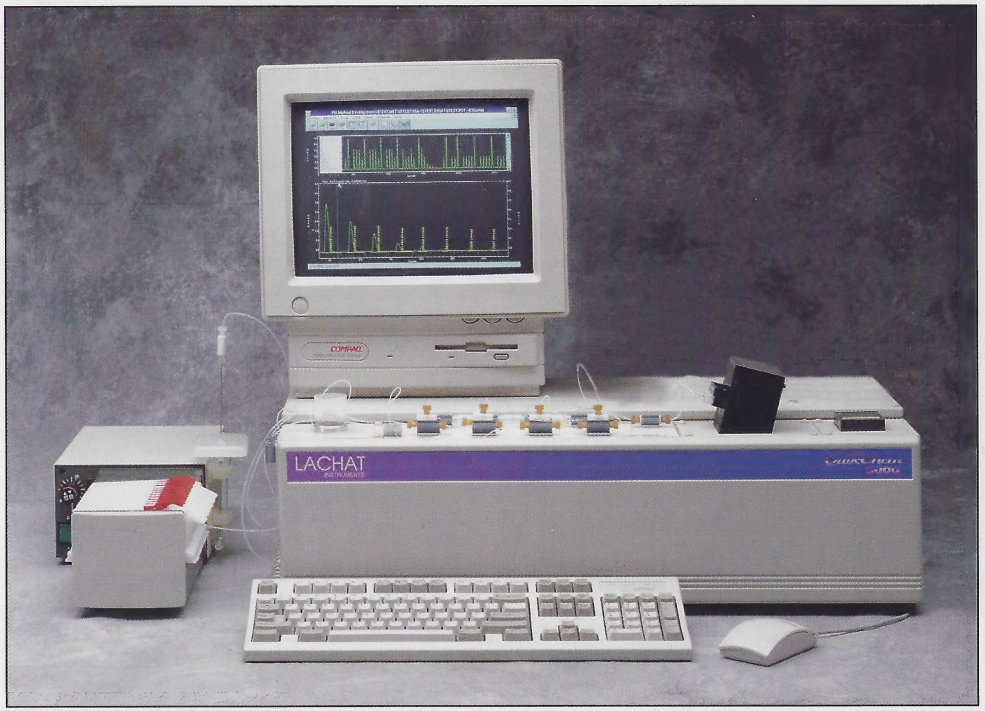
QuikChem 4000 Ion Analyzer

QuikChem 1000

The QuikChem 1000 is the entry-level model of the Continuum series. But don't be fooled by its low price. When you purchase a QuikChem 1000, you immediately get an instrument with high value-added. Even the least sophisticated system comes with a complete foundation consisting of the following components:

- 8 channel reagent pump, expandable to 32 channels
- Semi-automated Sampling Station, expandable to either a sequential or XYZ-based random access sampler
- System Unit with one Sample Processing Module, expandable to a total of 8
- Windows-based Data Station with Omnion FIA or Omnion IC software
- QuikChem FIA or IC methods that run on any QuikChem configuration

The QuikChem 1000 is field upgradable to any of the more advanced configurations whether you want to add pump channels, sample processing modules, one of the automatic samplers and a dilutor. You can also add FIA, IC and Mercury instruments in the field.



QuikChem 1000 Ion Analyzer

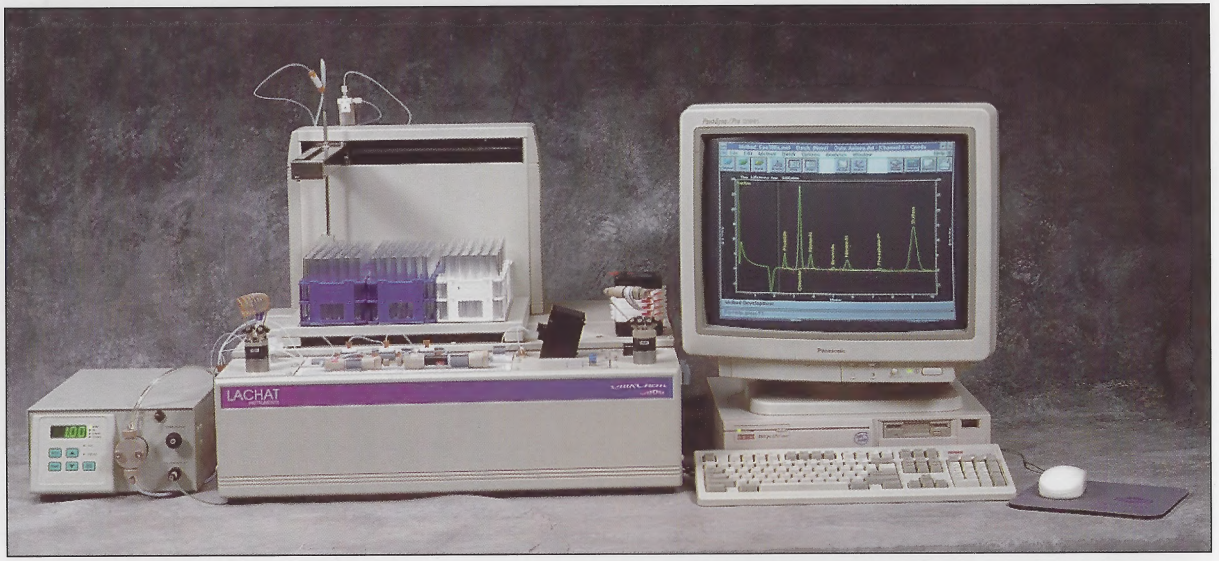
QuikChem Ion Chromatographs

QuikChem Ion Chromatographs offer leading edge features and broad flexibility in selection of instrument configurations:

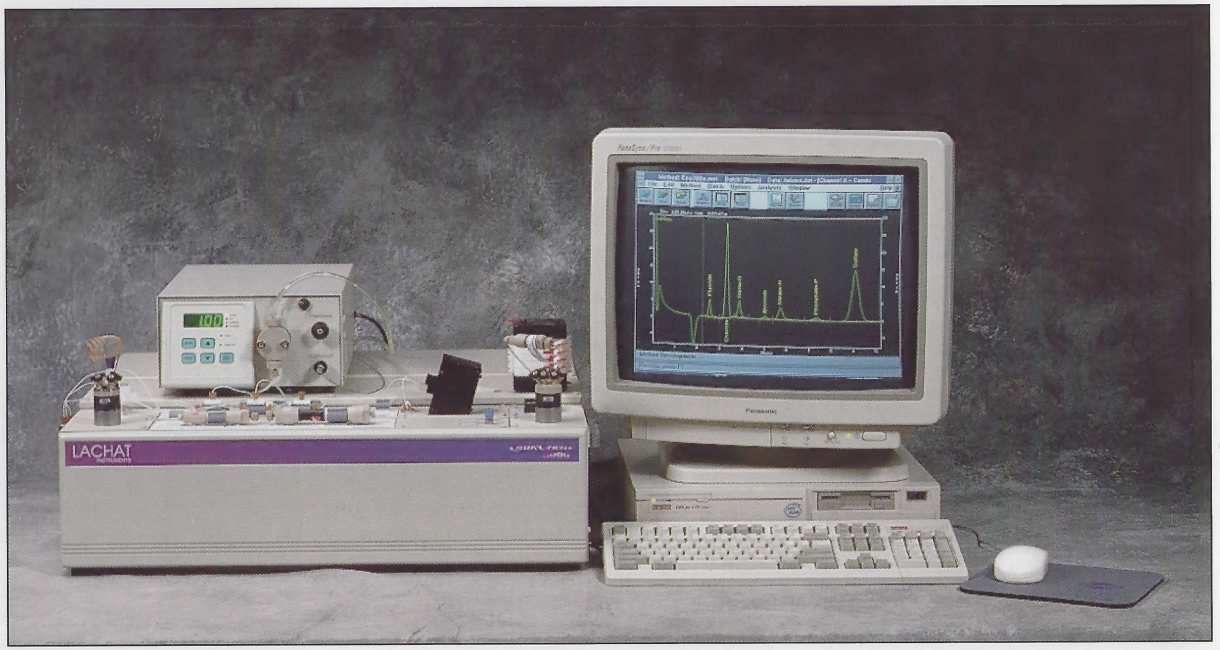
- Chemical suppression for high sensitivity
- Automatic in-line suppressor column regeneration
- Non-metallic flow path
- USEPA 300 series methods
- Economical entry level system field upgradable to more sophisticated configurations
- Data reduction with integrator or PC-based data station
- Expandable to 2 IC channels with integrator or 4 IC channels with PC-based data station
- All fluidic components are external for easy access and viewing
- Upgradable to CoWorker™ configurations for simultaneous and independent operation of flow injection analysis and mercury analysis

The QuikChem Ion Chromatographs provide you with everything you need to perform chemically-suppressed IC including:

- Isocratic eluent pump
- Electrically-actuated injection valve
- Chemical suppression system with automatic regeneration
- Ion profiling modules with guard and analytical columns
- Conductivity detector
- Integrator or PC-based data station
- QuikChem IC methods guaranteed for your application
- Autosampler-ready interface



QuikChem Ion Chromatograph with XYZ Sampler and PC Data Station



QuikChem Ion Chromatograph with Semi-Automated Sampling and PC Data Station

QuikChem Ion Chromatograph with Semi-Automated Sampling and Integrator

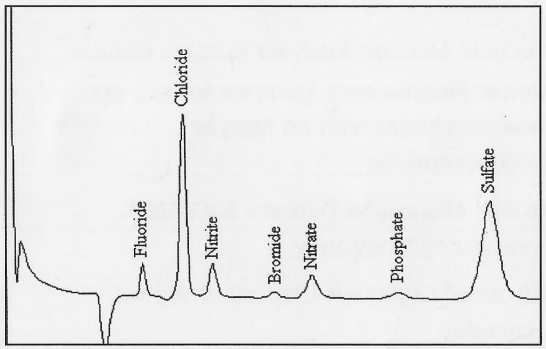
Chemical Suppression System

Chemical suppression is critical to performing ion chromatography with high sensitivity as it improves detection limits by two orders of magnitude compared to non-suppressed methods by:

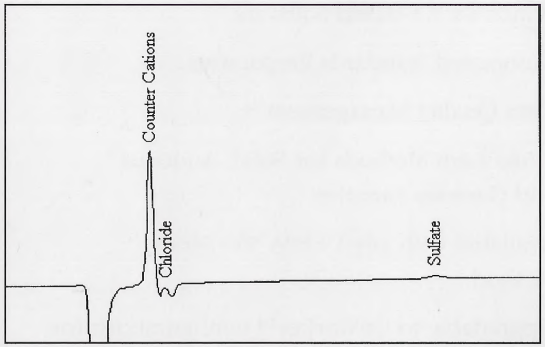
- Decreasing background eluent conductivity
- Enhancing analyte conductivity
- Eliminating sample counter ions

As the suppressor device is used, the capacity is reduced and it must either be replaced or regenerated. Replacement is inconvenient and expensive. Therefore, regeneration is the method of choice.

QuikChem Ion Chromatographs are equipped with a small, high capacity suppressor cartridge that is automatically regenerated after each sample is processed. Since regeneration is performed while the next sample is being loaded into the injection valve, there is no loss in productivity. In addition, regeneration after every sample ensures high precision and sensitivity.



Chromatogram with Chemical Suppression



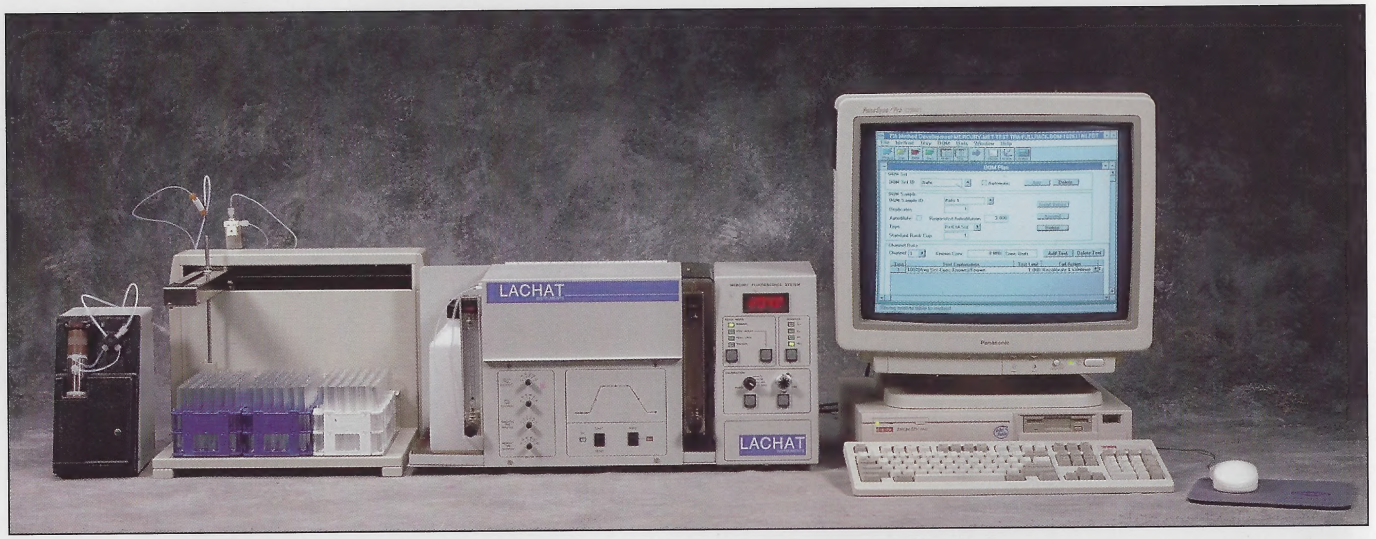
Chromatogram without Chemical Suppression

QuikChem Mercury Analyzers

QuikChem Mercury Analyzers are integrated systems of critical hardware and software components to provide turnkey solutions to the mercury analysis requirements of your laboratory. In addition to the atomic fluorescence (AF) and atomic absorption (AA) detectors, an advanced in-line vapor generator incorporating an extremely stable flow system is provided to reduce the mercury to a vapor prior to detection.

QuikChem Mercury Analyzer features include:

- Atomic Fluorescence Detector for Sub-ppt Detection Limits with no Sample Preconcentration
- Atomic Absorption Detector for USEPA Compliance Monitoring
- Advanced Computer-Controlled Vapor Generator
- Wide Dynamic Range -<1 ppt to 10 ppm
- High Sample Throughput
- Windows 3.1-Based Software
- Automated Standards Preparation
- Data Quality Management™
- QuikChem Methods for Solid, Aqueous and Gaseous Samples
- Available with any USEPA 300 Series Method
- Upgradable to CoWorker™ configurations for simultaneous and independent operation of flow injection analysis and ion chromatography



QuikChem Automated Mercury Analyzer

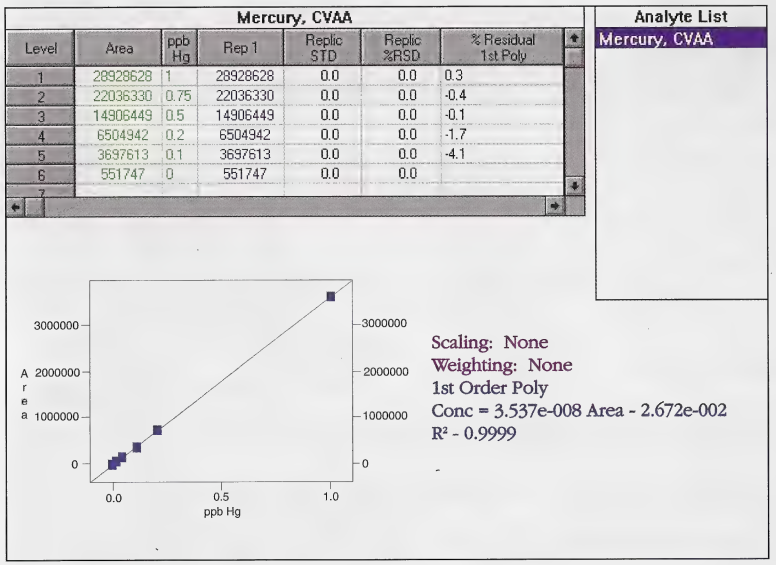
The QuikChem Mercury Analyzer is available as an automated stand-alone instrument with your choice of an XYZ Sampler as shown above or with a Sequential Sampler (not shown).

The Mercury Analyzer is also available with a Cyanide Analysis Option. This configuration enables mercury and cyanide to be determined on the same instrument platform wherein both instruments share the use of the Dilutor, Sampler, Software and Data Station as shown below.

QuikChem Automated Mercury Analyzer with Cyanide Analysis Option

QuikChem Semi-Automated Mercury Analyzer with PC

Finally, the QuikChem Mercury Analyzer can also be purchased as a Semi-Automated system with no auto sampler, but with a data station as shown above.



Mercury Calibration Curve

QuikChem 8000
CoWorker Series
IC / FIA / Hg

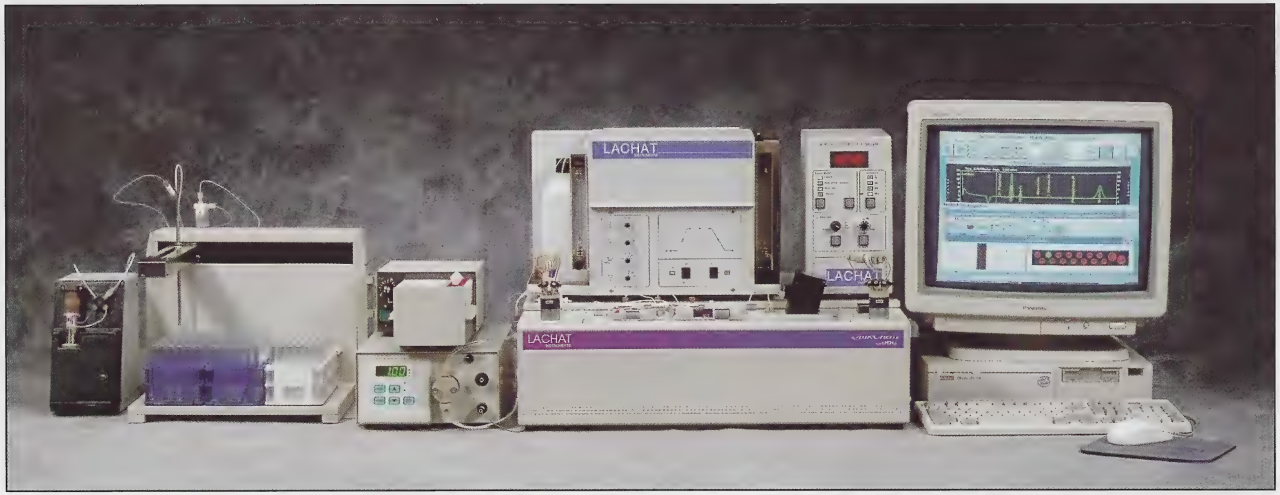
Ion chromatography (IC), multi-channel flow injection analysis (FIA) and mercury analysis (Hg) are complementary techniques for performing ion analysis. While IC enables samples to be separated into their component ions, FIA and Hg provide vehicles for highly efficient sample processing. The same laboratory often has diverse analytical requirements that can only be addressed by using all three techniques.

The QuikChem 8000 was designed from the beginning to incorporate IC, FIA and Hg operating together under a design framework called CoWorker. What is CoWorker?

coworker or co-worker
(ko'wûr'ker)

- noun - One that works with another; a fellow worker.

CoWorker is a unique hardware and software platform designed to enable multiple analytical techniques to be performed simultaneously and independently both during and after hours. Lachat's proprietary software system enables chemically-suppressed ion chromatography, multi-channel flow injection analysis and mercury analysis to all



QuikChem® 8000 Automated Ion Analyzer FIA/IC/Hg

be run on the same instrument, automatically, simultaneously, independently and unattended. With QuikChem, there is always an upgrade path available after you purchase to ensure that the instrument grows with your needs.

Although the features of each type of analyzer are detailed on the previous pages, following are the highlights describing the overall advantages of each technique.

- **Chemical Suppression with IC**
  Following separation of a sample into its component ions, the conductivity of the eluent is significantly reduced and the signal of the ions is enhanced using chemical suppression. This technique increases detection sensitivity by over 100 times compared to single column methods and is ideal for profiling a sample for its component ionic constituents.

- **High Productivity with FIA**
  When you need to process high numbers of samples, simply run the FIA instrument for typical sample throughputs of 90 - 120 per hour. Run multiple channels simultaneously, or switch over quickly from one method to another.

- **High Sensitivity with Hg**
  The QuikChem Mercury Analyzer enables the determination of mercury at sub-ppt levels using atomic fluorescence detection. It is also available with an atomic absorption detector for USEPA compliance monitoring.

- **Decreased Footprint**
  The QuikChem 8000 with IC, FIA and Hg reduces required benchspace by at least 100% compared to that required for three separate instruments.

- **Unified Customer Training and Support**
  Now one company provides installation, training, applications and technical support for IC, FIA and Hg. This enables one user to operate all three instruments and reduces training and support costs.

The QuikChem 8000 CoWorker - Today's Solutions for Tomorrow's Problems[sm].

Without a doubt, the QuikChem CoWorker is the most flexible solution on the market to exactly meet your ion analysis needs - today and tomorrow.

QuikChem Continuum Ion Analyzer Series (Table 1)

QuikChem 8000 Series - FIA/IC/Hg

	FIA	IC	Hg	XYZ Sampler	Sequential Sampler	Sampling Station	Reagent Pump	System Unit	Sample Processing Module	Omnion FIA/Hg Software	Omnion IC Software	20-Bit A-D Converter	IC Conductivity Detector	IC Suppression System	IC Eluent Pump	Hg Vapor Generator	Hg AF/AA Detector	Digital Dilutor
QuikChem 8000-A	x			1			1	1	1 to 8	1		1						Optional
QuikChem 8000-B		x		1			1	1	1 or 2		1	1	1 or 2	1 or 2	1 or 2			Optional
QuikChem 8000-C	x	x		1			1	1	1 to 8	1		1	1 or 2	1 or 2	1 or 2			Optional
QuikChem 8000-D			x	1						1	1	1				1	1	Optional
QuikChem 8000-E	x		x	1			1	1	1 to 7	1		1				1	1	Optional
QuikChem 8000-F	x	x	x	1			1	1	1 to 7	1	1	1	1 or 2	1 or 2	1 or 2	1	1	Optional

QuikChem 4000 Series - FIA/IC/Hg

	FIA	IC	Hg	XYZ Sampler	Sequential Sampler	Sampling Station	Reagent Pump	System Unit	Sample Processing Module	Omnion FIA/Hg Software	Omnion IC Software	20-Bit A-D Converter	IC Conductivity Detector	IC Suppression System	IC Eluent Pump	Hg Vapor Generator	Hg AF/AA Detector	Digital Dilutor
QuikChem 4000-A	x				1		1	1	1 to 8	1		1						n/a
QuikChem 4000-B		x			1		1	1	1 or 2		1	1	1 or 2	1 or 2	1 or 2			n/a
QuikChem 4000-C	x	x			1		1	1	1 to 8	1	1	1	1 or 2	1 or 2	1 or 2			n/a
QuikChem 4000-D			x		1					1		1				1	1	n/a
QuikChem 4000-E	x		x		1		1	1	1 to 7	1		1				1	1	n/a
QuikChem 4000-F	x	x	x		1		1	1	1 to 7	1	1	1	1 or 2	1 or 2	1 or 2	1	1	n/a

QuikChem 1000 Series - FIA/IC/Hg

	FIA	IC	Hg	XYZ Sampler	Sequential Sampler	Sampling Station	Reagent Pump	System Unit	Sample Processing Module	Omnion FIA/Hg Software	Omnion IC Software	20-Bit A-D Converter	IC Conductivity Detector	IC Suppression System	IC Eluent Pump	Hg Vapor Generator	Hg AF/AA Detector	Digital Dilutor
QuikChem 1000-A	x					1	1	1	1 to 8	1		1						n/a
QuikChem 1000-B		x				1	1	1	1 or 2		1	1	1 or 2	1 or 2	1 or 2			n/a
QuikChem 1000-C	x	x				1	1	1	1 to 8	1	1	1	1 or 2	1 or 2	1 or 2			n/a
QuikChem 1000-D			x			1				1		1				1	1	n/a
QuikChem 1000-E	x		x			1	1	1	1 to 7	1		1				1	1	n/a
QuikChem 1000-F	x	x	x			1	1	1	1 to 7	1	1	1	1 or 2	1 or 2	1 or 2	1	1	n/a

Block Digestors

46 and 26 Tube Positions

The BD-46 performs high temperature Kjeldahl digestions in 46 x 75 mL tubes primarily on water samples for the determination of total nitrogen and total phosphorus. With six more positions than are available on other blocks, calibration standards can be carried through the digestion process to increase accuracy and precision without decreasing productivity.

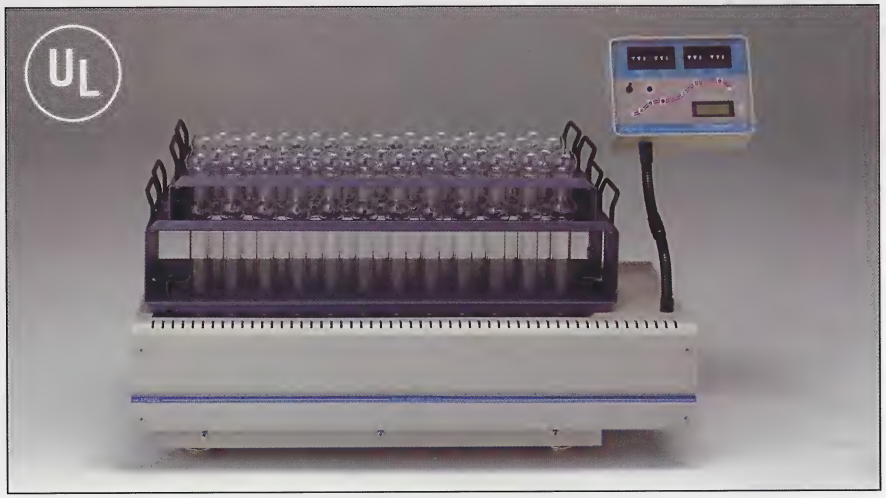
The BD-26 enables digestion of 26 samples prior to the determination of metals by AA or ICP. The unit was specifically designed to meet the analytical and QC protocol requirements of the USEPA's CLP Inorganics Statement of Work for determining metals in water, soil, sediment, sludge and oil.

The BD-26 is also used for performing Kjeldahl digestions on solid samples. These include soils, plants, animal feeds and foodstuffs. The large 250 mL tubes allow a representative sample to be digested to improve accuracy and precision.

Both the BD-46 and BD-26 incorporate several innovative features including...

- Anti-foaming bulb to reduce boil-over due to sample surfactants
- Cold fingers to condense and recover virtually all acid fumes
- Integral programmable controller mounted high on a flexible arm to improve visibility and prevent damage due to spillage
- UL listed

Many discharge water samples contain varying levels of surfactants which will cause foaming of the sample during digestion. This foam often overflows from conventional tubes onto the heated block. The special design of both the 75 mL and 250 mL tubes incorporates a bulb towards the top which breaks up most foams and prevents overflow.



BD-46

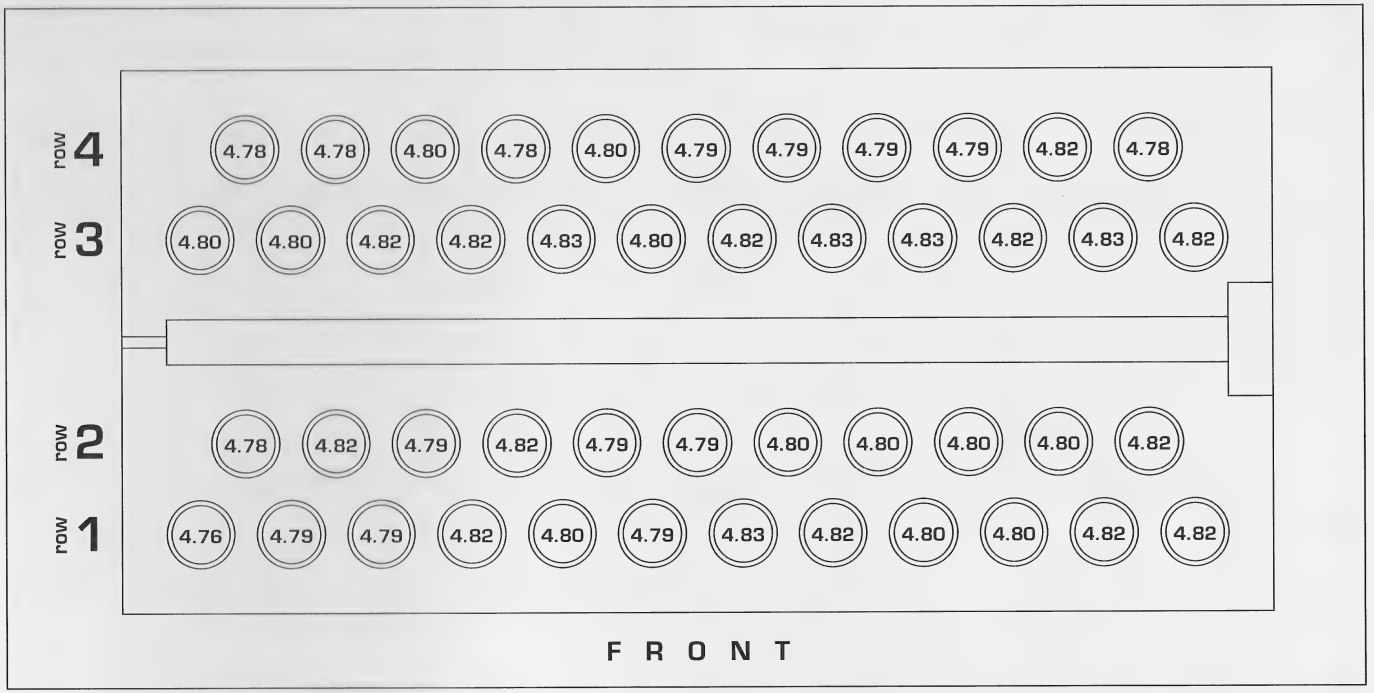
BD-26

The BD-46 and BD-26 also come with cold fingers. These are inserted into the tops of the digestion tubes and serve to condense the acid fumes and return the condensate to the tube. This feature significantly reduces fuming and improves refluxing.

Other block digestors have controllers that are separate from the block and sit on the bench where they are exposed to spillage and are difficult to view. The programmable controller for the BD-46 and BD-26 is attached to the block on a flexible arm which keeps it high and dry, away from spillage, and makes it easily adjustable for varied viewing angles.

In order to measure the accuracy and precision of the Lachat Block Digestors, a mapping study was performed with the BD-46. Each tube was filled with 20 mL of water and 5 mL of a 20% (v/v) sulfuric acid solution also containing potassium sulfate and mercury catalyst. The block was then taken through a digestion cycle and each tube was assessed for recovery of acid. The block map and table to the right summarize the results, which confirm the excellent accuracy and precision capabilities of the digestion system.

Results: Block Diagram



Row	% Acid (v/v)	Std. Dev.	% RSD	% Recovery
1	4.80	0.02	0.41	99.0
2	4.80	0.01	0.28	99.0
3	4.82	0.01	0.25	99.4
4	4.79	0.01	0.25	98.8

Distillation Systems

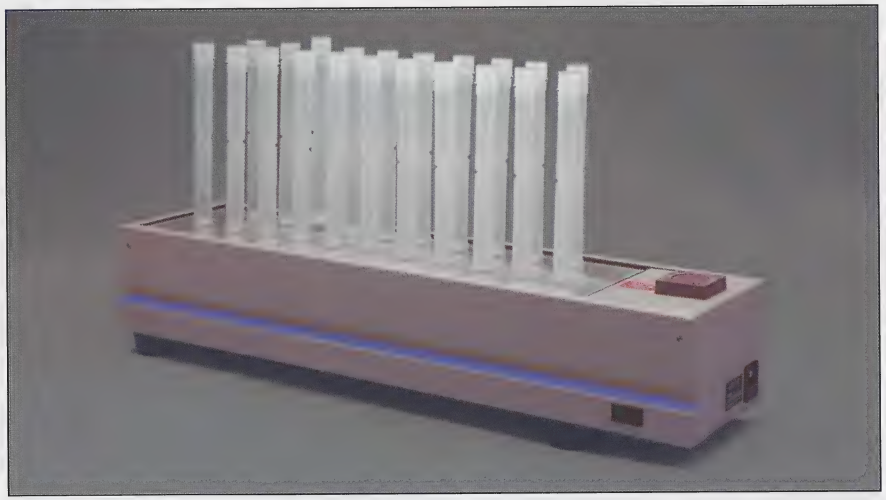
MICRO DIST®

The MICRO DIST System from Lachat Instruments is the most versatile and easy-to-use instrument available for the rapid distillation of cyanides, phenolics, sulfides, ammonia and other volatile analytes.

What does this mean for your laboratory?

- Very short distillation times of only 30 to 90 minutes
- Distillation of up to 21 samples simultaneously
- Increased ease-of-use with minimal setup time and no tear down required
- Disposable distillation tubes so there is no glassware to wash and maintain
- Improved precision since all samples are treated identically

In a word, increased ***productivity.***

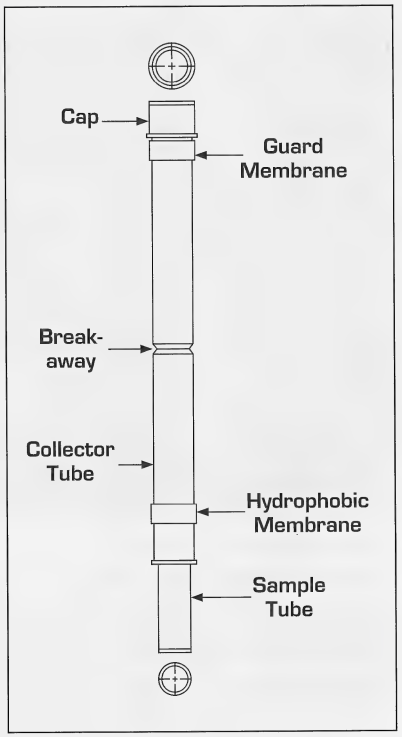


MICRO DIST Block

For the determination of cyanides, total recoverable phenolics and other volatile analytes, a significant impediment to productivity is the required pre-distillation of the sample. The classical method employing large volume glassware is both expensive and time-consuming.

In response to the need for a more efficient distillation method, Lachat Instruments developed the MICRO DIST system. This product quantitatively reduces the volumes of samples and reagents specified in USEPA methods 335.2 for cyanides and 420.1 for phenolics delineated in Methods for Chemical Analysis of Waters and Wastes.

Drawing on the analogy of a block digestor, the MICRO DIST is a batch micro-distillation system using sample volumes of about 6 mL. The key to the system is a patented disposable distillation tube assembly shown in the diagram to the right.
In practice, the sample is dispensed into a sample tube which is inserted into the collector tube containing a hydrophobic membrane. Up to 21 tubes are



MICRO DIST Tube Assembly

then inserted into the heating block where the sample is boiled with the resulting vapor passing through the membrane, condensing and being collected above the membrane.

Following completion of the distillation - 30 minutes for cyanides and 90 minutes for phenolics - the tube is broken in half and the distillate is brought up to a volumetric mark. For automated analysis, the sample is dispensed into a sample tube and run directly. Manual sample handling by the analyst is minimized and samples are distilled under significantly more reproducible conditions than those of a macro-distillation procedure.

The table to the right compares the characteristics of MICRO DIST with the macro-distillation method.

Macro-distillation	MICRO DIST
There are many fragile pieces to disassemble, clean and reassemble between each distillation	The MICRO DIST tube consists of only two pieces which are disposed of after use
Leaks at glass joints are a major cause of low recoveries and cyanide leaks	The tube has one plastic press-fit joint that will never leak
The flow rate of the purge gas stream is critical	The *in situ* steam is self-purging so no external gas stream is required
Irregular contact with the heating mantle causes variable heating for each sample	The high contact block heater is temperature controlled for high precision across all samples
Provides 100% recovery of most metal-cyanide complexes (1)	Provides 100% recovery of most metal-cyanide complexes (1)

1. Continuous flow distillations often give variable and incomplete recoveries.

Lachat Instruments
The World Leader
in Flow Injection Analysis

To receive additional information on any of the products described in this catalog, please complete and mail the enclosed literature card.

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